

## 6. COMPARISON OF MEASURED CONCENTRATIONS TO EFFECTS THRESHOLDS

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The methods and results of the comparison of measured concentrations to effects thresholds are presented in this section.

### 6.1. Comparison Methods

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Measured chemical concentrations were compared to effects thresholds using the Hazard Quotient (HQ) approach (Barnthouse et al. 1986; Suter et al. 1992), where:

$$HQ = \frac{\text{Measured Concentration}}{\text{Effects Threshold}}$$

For this analysis, an  $HQ > 1$  suggests that the chemical may be present at a high enough concentration to adversely affect aquatic communities. Note that an  $HQ > 1$  does not necessarily mean that a chemical is adversely affecting the aquatic community, only that it may potentially be affecting the community and warrants further investigation. All HQ calculations can be found in Appendix E.

For comparison of pesticide and BNA organics concentrations, each of the detected pesticide and BNA organic results were directly compared to the effects thresholds using the HQ approach described above. For comparison of metal concentrations to standards and/or criteria based on the dissolved fraction, the dissolved measurement should be directly compared to the effects threshold. Seven of the 14 detected metals have standards based on the dissolved fraction. However, no dissolved measurements were made in 1999 (i.e., only total recoverable metal was measured). In 2000, however, both total and dissolved metals were measured. Therefore, for those metals with total and dissolved metal concentrations detected in 2000 (copper, lead and zinc), metal-specific total-to-dissolved translators (i.e., ratios) were calculated and then applied to the 1999 data (for metals with dissolved standards/criteria). A metals translator is the ratio of total-to-dissolved concentrations for a given metal sample. This translator can then be applied to other total concentration data to estimate dissolved concentrations (U.S. EPA 1996b).

For copper, lead and zinc, metal-specific total-to-dissolved translators were calculated from total and dissolved metals results from additional monitoring conducted in Lyon, Little Bear and Swamp creeks in 2000 (unpublished data). Table 5-1 depicts the total and dissolved metals results and the resulting translators (dissolved concentration/total concentration). These translators were then applied to the 1999 total copper, lead and zinc concentrations to estimate the dissolved concentration. For each metal, the average translator from all creeks was used to adjust the total copper, lead and zinc concentrations measured in Lewis, Juanita and Rock creeks. The Lyon Creek-specific translator was used

to adjust the Lyon Creek total copper, lead and zinc results. Therefore, hazard quotients for these three metals were based upon the estimated dissolved concentrations.

For the four detected metals with standards based on the dissolved fraction and for which translator data were not available (arsenic, cadmium, chromium (VI), and nickel), total metal concentrations were directly compared to the effects thresholds, even if they were based on dissolved standards. Since the total concentration likely over-estimates the bioavailable fraction of the metal, this approach is conservative.

**Table 5-1. Total and dissolved copper, lead and zinc concentrations from monitoring conducted in 2000 (unpublished data).**

|                                       |                         | Cu (µg/L)    | Pb (µg/L)    | Zn (µg/L)    |
|---------------------------------------|-------------------------|--------------|--------------|--------------|
| <b>Lyon Creek</b>                     | Total                   | 6.9          | 9.6          | 50.2         |
|                                       | Dissolved               | 2.68         | 0.26         | 6.38         |
|                                       | Translator <sup>a</sup> | 0.388        | 0.027        | 0.127        |
|                                       |                         |              |              |              |
| <b>Little Bear Creek</b>              | Total                   | 3.5          | 2.33         | 24.2         |
|                                       | Dissolved               | 1.9          | 0.2          | 7.14         |
|                                       | Translator              | 0.543        | 0.086        | 0.295        |
|                                       |                         |              |              |              |
| <b>Swamp Creek</b>                    | Total                   | 1.5          | 0.89         | 7.43         |
|                                       | Dissolved               | 0.94         | --           | 1.4          |
|                                       | Translator              | 0.627        | --           | 0.188        |
|                                       |                         |              |              |              |
| <b>Average Translator<sup>b</sup></b> |                         | <b>0.519</b> | <b>0.056</b> | <b>0.204</b> |
| <b>Standard Deviation</b>             |                         | <b>0.121</b> | <b>0.042</b> | <b>0.085</b> |

<sup>a</sup> The Lyon Creek translators were used to adjust total copper, lead and zinc concentrations measured in Lyon Creek

<sup>b</sup> The average translator was used to adjust total copper, lead and zinc concentrations in Lewis, Juanita and Rock creeks

For the metal and BNA organic parameters that were detected at least once, if the result for a given sample was below the method detection limit (MDL), then the concentration was assumed to be equal to one-half of the MDL. Since effects thresholds are already available for these results, this provides an easy way to evaluate the toxicological relevance of the detection limits. All of these calculations can be found in Appendix E.

## 6.2. Comparison Results

A summary of the comparison of measured concentrations to effects thresholds is provided in Table 5-2. Complete results are available in Appendix E.

**Table 5-2. Minimum and maximum hazard quotients for parameters detected in 1998 and 1999.**

|                       | n  | Number detected | Min HQ <sup>a</sup> | Max HQ <sup>a</sup> |
|-----------------------|----|-----------------|---------------------|---------------------|
| <b>Chemical</b>       |    |                 |                     |                     |
| 2,4-D                 | 15 | 10              | 0.0005              | 0.0230              |
| 2,6-Dichlorobenzamide | 15 | 8               | 0.0000              | 0.0000              |
| 4-Nitrophenol         | 15 | 3               | 0.0000              | 0.0001              |
| 4,4'-DDD              | 15 | 2               | 0.0233              | 0.0311              |
| 4,4'-DDE              | 15 | 2               | 0.0025              | 0.0033              |
| 4,4'-DDT              | 15 | 4               | 0.0571              | 2.4000              |
| Atrazine              | 15 | 3               | 0.0012              | 0.0062              |
| Bromacil              | 15 | 1               | 0.0009              | 0.0009              |
| Carbaryl              | 15 | 4               | 0.0036              | 0.0360              |
| Diazinon              | 15 | 9               | 0.1444              | 4.7222              |
| Dicamba               | 15 | 7               | 0.0004              | 0.0013              |
| Dichlobenil           | 15 | 10              | 0.0000              | 0.0001              |
| Dichlorprop           | 15 | 3               | 0.0000              | 0.0000              |
| Malathion             | 15 | 3               | 0.1000              | 0.3700              |
| MCPA                  | 15 | 3               | 0.0000              | 0.0001              |
| MCPP                  | 15 | 9               | 0.0000              | 0.0003              |
| Metolachlor           | 15 | 1               | 0.0284              | 0.0284              |
| Napropamide           | 15 | 1               | 0.0000              | 0.0000              |
| Pentachlorophenol     | 15 | 9               | 0.0014              | 0.0116              |
| Prometon              | 15 | 9               | 0.0002              | 0.0023              |
| Simazine              | 15 | 7               | 0.0130              | 16.2541             |
| Trichlorpyr           | 15 | 10              | 0.0003              | 0.0028              |
| Trifluralin           | 15 | 2               | 0.0019              | 0.0130              |
| <b>Metals</b>         |    |                 |                     |                     |
| Aluminum              | 1  | 1               | 13.9080             | 13.9080             |
| Antimony              | 13 | 4               | 0.0083              | 0.0263              |
| Arsenic               | 13 | 12              | 0.0013              | 0.0432              |
| Barium                | 13 | 13              | 0.0012              | 0.0249              |
| Beryllium             | 13 | 1               | 0.0189              | 0.0396              |
| Cadmium               | 13 | 3               | 0.0478              | 0.7613              |
| Chromium              | 13 | 12              | 0.0020              | 0.2498              |
| Cobalt                | 10 | 9               | 0.0196              | 1.5157              |
| Copper                | 13 | 13              | 0.0765              | 2.0172              |
| Lead                  | 13 | 10              | 0.0022              | 1.3495              |
| Molybdenum            | 13 | 3               | 0.0003              | 0.0007              |
| Nickel                | 13 | 12              | 0.0044              | 0.3408              |

|   | n  | Number detected | Min HQ <sup>a</sup> | Max HQ <sup>a</sup> |
|---|----|-----------------|---------------------|---------------------|
| Vanadium                                | 10 | 10              | 0.0105              | 0.7634              |
| Zinc                                    | 13 | 12              | 0.0039              | 0.3723              |
| <b><i>BNA Organics (Lyon Creek)</i></b> |    |                 |                     |                     |
| Benzoic acid                            | 2  | 1               | 0.0000              | 0.0000              |
| bis(2-ethylhexylphthalate)              | 2  | 2               | 0.0009              | 0.0031              |
| Caffeine                                | 2  | 2               | 0.0000              | 0.0000              |

<sup>a</sup> Although HQs may be based on either measured results for detected parameters or one-half MDL for non-detected parameters, all of the HQs > 1.0 were based on detected results.

### 6.2.1. Pesticides

In summary, only three pesticides were detected at concentrations that exceeded effects thresholds; 23 pesticides were detected at concentrations that did not exceed effects thresholds. In Lyon Creek, diazinon and simazine concentrations exceeded the effects threshold during the May 1998 and June 1999 sampling events, and 4,4'-DDT exceeded effects thresholds in November 1999. Additionally, in Juanita Creek, diazinon and 4,4'-DDT exceeded effects thresholds during the November 1999 sampling event. None of the pesticides detected in Rock Creek in May 1998 or Lewis and Rock creeks in 1999 exceeded effects thresholds.

### 6.2.2. Metals

Of the metals detected in 1999, only four were detected at concentrations exceeding effects thresholds; ten metals were detected at concentrations that did not exceed effects thresholds. In Lyon Creek, copper (June 1999) and aluminum (November 1999) exceeded the screening threshold. In Juanita Creek, cobalt (June 1999), copper (June and August 1999), and lead (June 1999) exceeded effects thresholds. None of the metals detected in Lewis or Rock creeks in 1998 or 1999 exceeded effects thresholds. Furthermore, assuming concentrations equal to one-half the MDL for non-detected parameters did not result in any HQs greater than 1.0.

### 6.2.3. BNA Organics

Only three BNA organic chemicals (benzoic acid, bis(2-ethylhexyl)phthalate, and caffeine) were detected in the samples collected from Lyon Creek in June and August 1999. None exceeded effects thresholds.